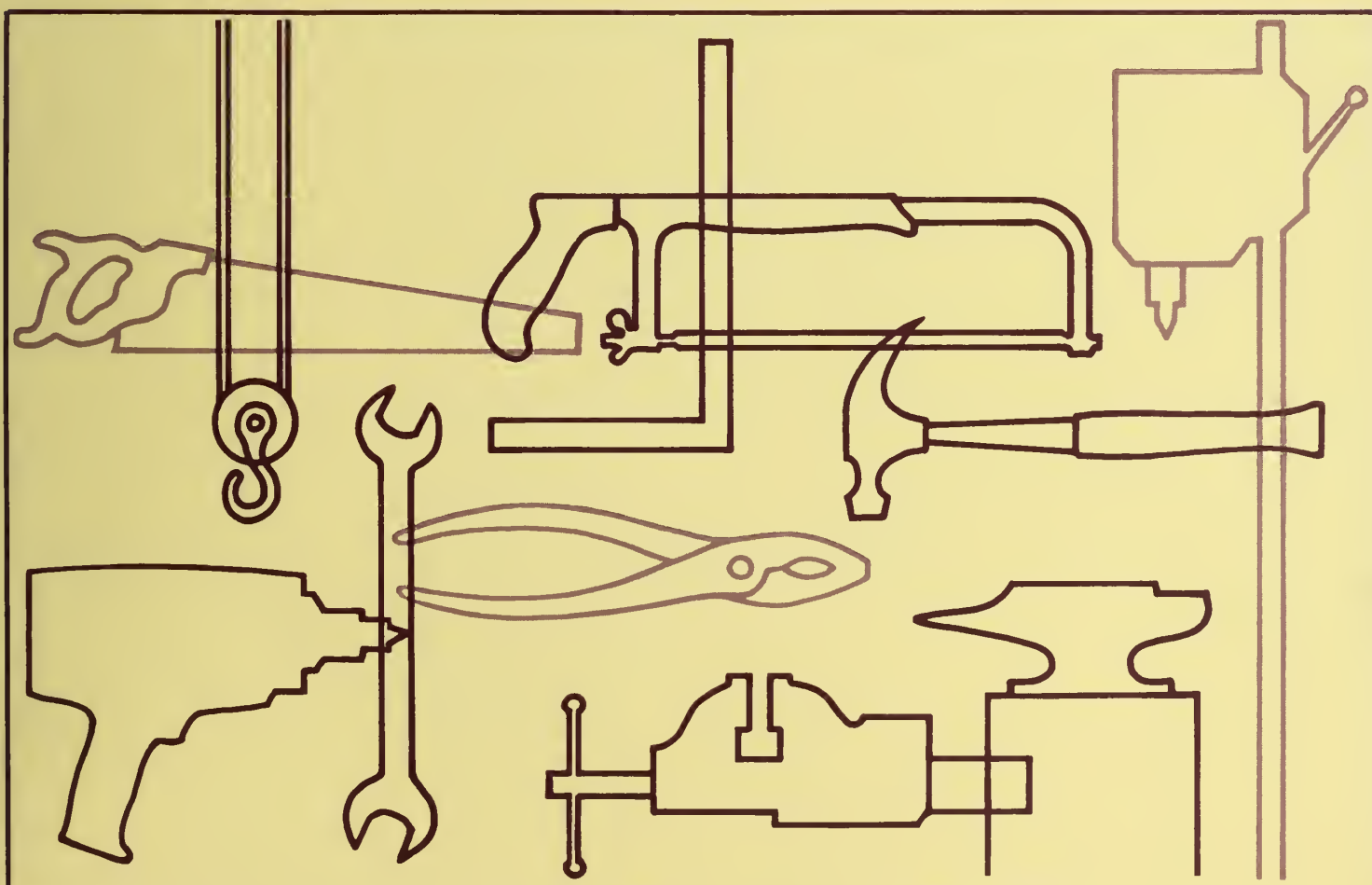


FARM WORKSHOPS

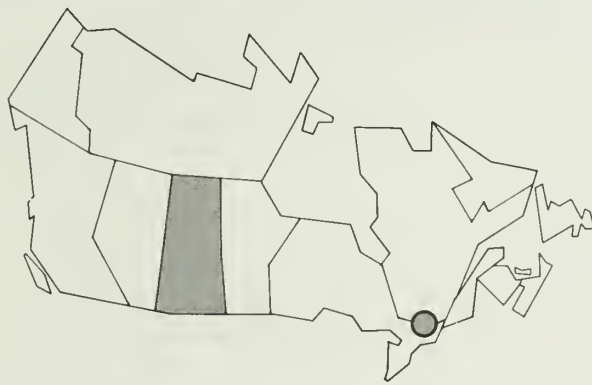


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FARM WORKSHOPS

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FARM WORKSHOPS

A properly equipped workshop is essential to the efficient operation of a farm enterprise. Prolonged equipment breakdowns must be minimized by regular servicing of farmstead systems and by fast, effective repairing of farm machinery. Overall farm labor efficiency can be significantly improved by providing good shop facilities in which equipment maintenance and repair jobs can be carried out on days of stormy weather or other slack periods. It is also possible for an ingenious operator to effect substantial savings in constructing or rebuilding equipment to suit his particular needs.

Before building and equipping a shop, make a long-range assessment of anticipated need for on-farm repair facilities. Consider the availability, proximity and cost of commercial services as well as your interest and ability in doing shop work. Although economic factors are of prime importance, keep in mind that a good farm shop will also provide an opportunity for you and your family to pursue hobbies and sideline activities. The time saved and frustration avoided in having tools, repair parts and supplies stored together are reasons enough to seriously consider some type of centralized shop facility.

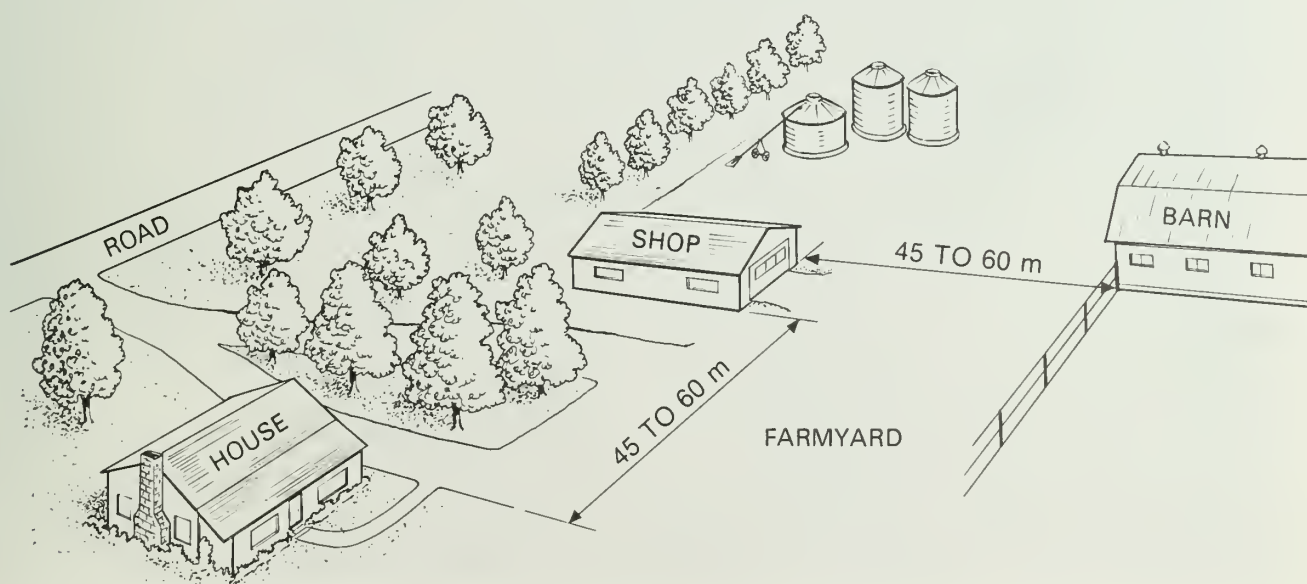
An ideal farm workshop is a service center for equipment maintenance, routine overhauls and emergency repairs as well as a storage for tools and hardware supplies. It should not be a substitute for a commercial dealer's facilities where special tools and trained technicians are available for complex repair jobs.

CHOOSING A LOCATION

While workshops can be built in conjunction with machinery storage sheds, it is preferable to have a completely separate building to minimize fire hazard and reduce traffic congestion around the shop.

The shop should be the hub of farmstead traffic (Figure 1). If possible, select a site that is slightly elevated, to ensure good drainage and prevent accumulation of water in or around the shop; close to electrical and water services; and within easy communicating distance of the house. The shop should be at least 45 m from other buildings to allow future expansion, reduce fire hazard and facilitate maneuvering and parking of equipment nearby. Locate the building so that the main doors face away from prevailing winds and plan the surrounding landscaping to minimize snow accumulation in front of the shop.

Figure 1 Note centralized location of the farm shop in relation to traffic pattern



DETERMINING SPACE REQUIREMENTS

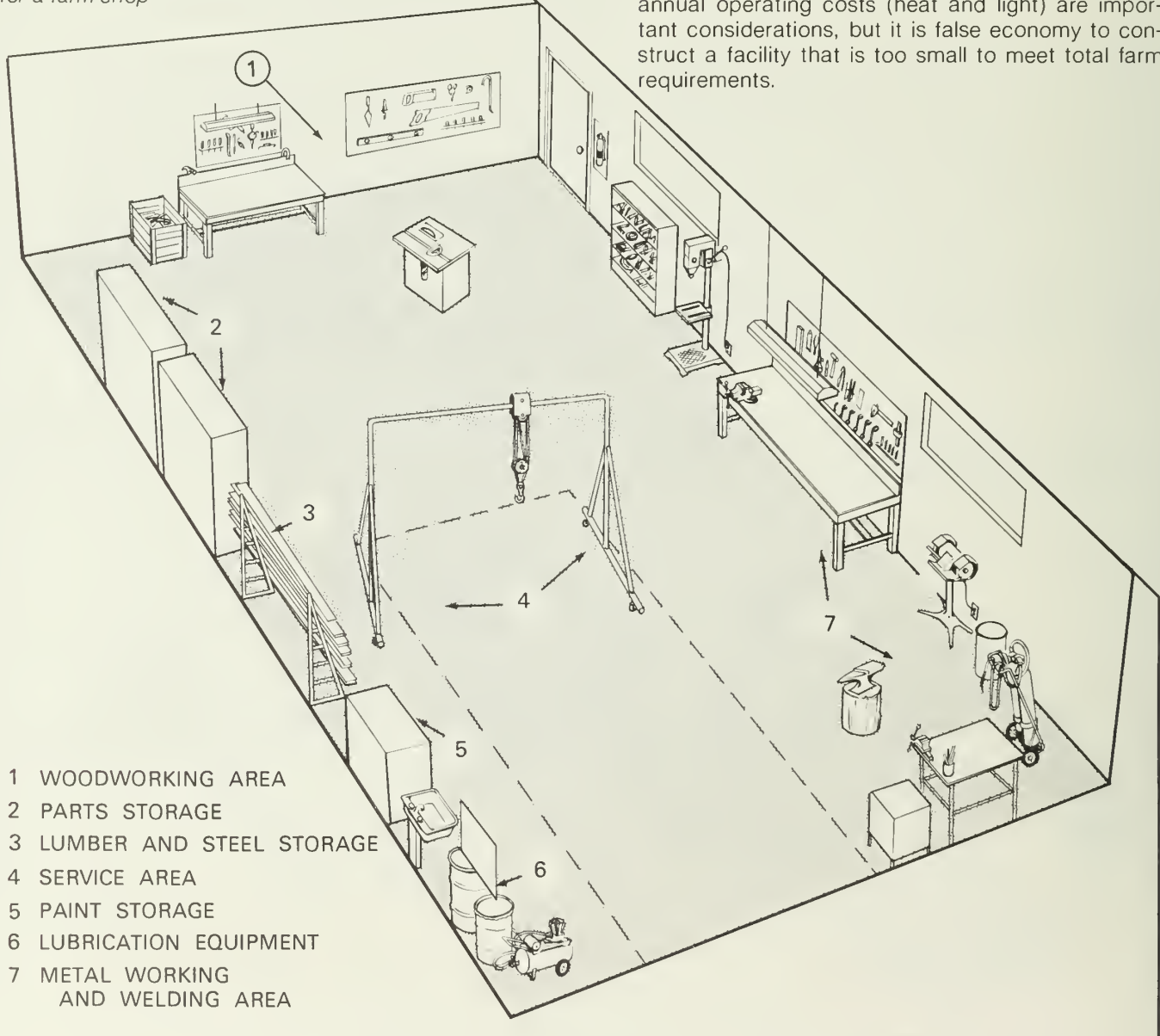
In general, the size of the farm shop is determined by the extent, number and nature of the enterprises involved in the total farm operation. Each type of enterprise requires special tools and equipment, as well as adequate space to carry out maintenance and repairs. The shop should, therefore, be sized and equipped to accommodate the total needs of the farm, with the possible exception of such machines as self-propelled combines. Consider, also, the possibility of using the farm shop for day-to-day storage of a tractor or truck.

A rectangular building, at least 8.4 m wide and 10.8 m long, with the main door at one end provides the

greatest flexibility in the use of space (Figure 2). The area immediately inside the main door and extending back far enough to accommodate a large tractor or farm truck is best suited for use as the service area for machines to be worked on. Depending on the size of the machines, the recommended minimum width of this area is 3.6 m. Space must be allowed on both sides for workbenches, storage cupboards, shop equipment and general access. Also remember to provide space to maneuver lifting devices and to set machine parts removed during overhaul. When planning the length of the building, provide sufficient space for doing odd jobs when the service area is occupied.

In planning a farm workshop one of the most critical and difficult decisions to make is what size of building to construct. Initial capital investment and annual operating costs (heat and light) are important considerations, but it is false economy to construct a facility that is too small to meet total farm requirements.

Figure 2 A typical basic floor layout for a farm shop



THE BUILDING

Since farm shops have no unique structural requirements, satisfactory shop buildings can be built utilizing stud frame, rigid frame, arch rafter (Figure 3), trussed rafter, pole type construction (Figure 4) or concrete building blocks. A primary requirement is that the building be of clear span construction so that the floor is free of roof support columns. In determining the type of construction to erect, investigate the cost of various materials and amount of labor required. Be sure that the type of building selected will provide the ceiling height and door size required to accommodate the machines to be worked on. Some shop building plans are available through the Canada Plan Service.

Foundation

Foundation requirements vary, depending on the type of building to be constructed. Seek technical advice from building suppliers or local Department of Agriculture extension agricultural engineers in designing the foundation after the basic building plan has been decided upon. It is especially important to have a sound foundation for the wall section in which the main door is located, as any uneven movement in that wall will eventually result in a poorly fitting door.

Floor

Use reinforced, medium strength, air-entrained concrete 150 mm thick for the shop floor and apron

area outside the main entrance. In preparation for laying the floor, excavate the earth to a depth of 300 mm below the proposed finished floor level. Before pouring the concrete, wet down and compact a 150 mm layer of sand, gravel or crushed rock. Reinforcing material can be either welded wire mesh or 10 mm rods spaced approximately 450 mm on center each way.

Trowel the surface of the concrete smooth and treat it with a sealant to facilitate cleaning and to prevent liquid penetration. The floor should have a 1% slope either toward the main door or to a drain sump, so that liquids cannot accumulate on the shop floor. If an internal sump is installed, build it of concrete approximately 900 mm square by 450 mm deep and cover it with a heavy steel grate. Liquids and sediment accumulating in this sump can be cleaned out by using a pail and shovel.

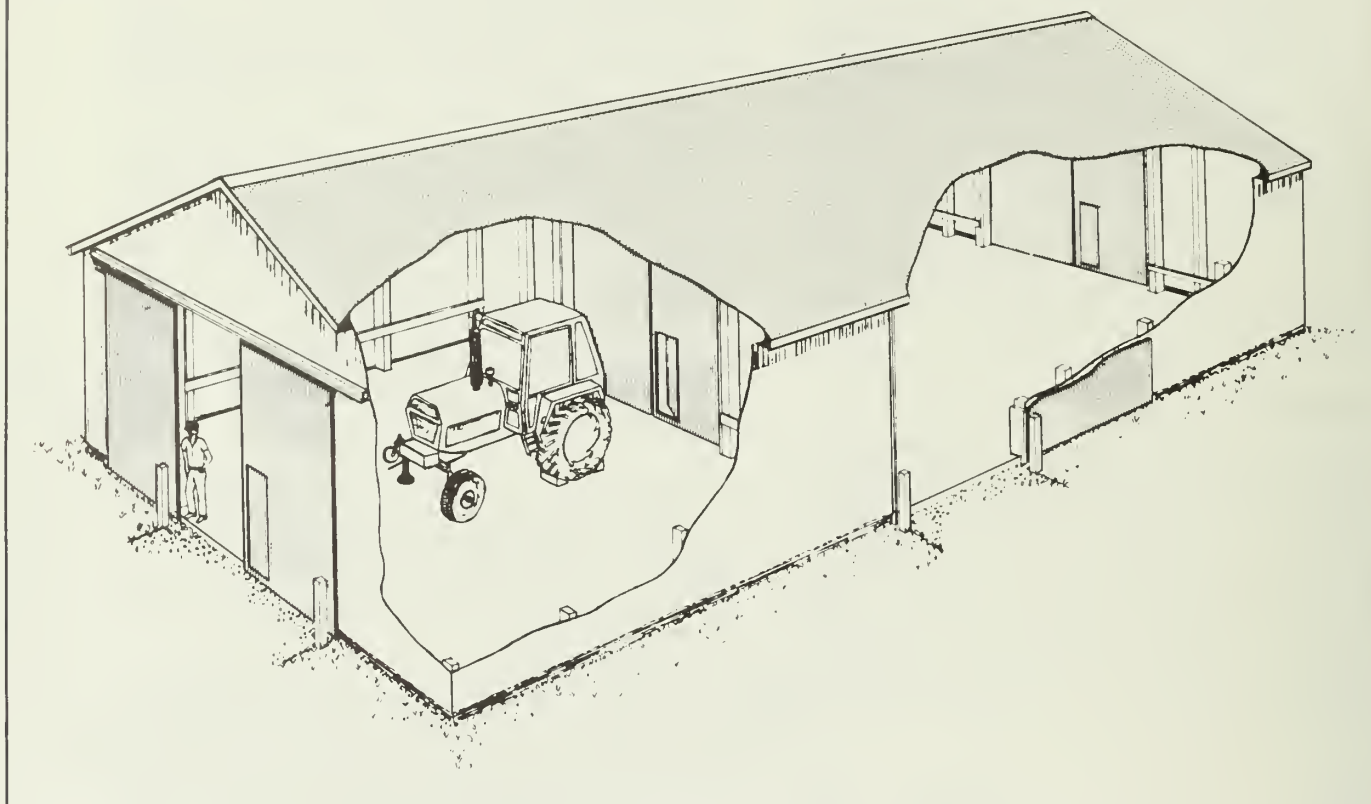
The installation of a service pit is not recommended because it is a safety hazard and tends to become a collector sump for garbage, liquids and toxic or flammable gases. An overhead hoist of some type is a more practical way to facilitate servicing the underside of vehicles.

A convenience that might be incorporated when constructing the floor is an arrangement of standardized tool anchors set flush with the concrete floor and securely welded to the reinforcing steel below. These can be used for bolting down tools such as steel bending machines where large uplift forces are encountered.



Figure 3 A standard arch rafter farm workshop

Figure 4 A combined workshop and machinery storage building using pole-frame construction with truss roof



Walls and Ceiling

The height of the walls is determined by the overall ceiling clearance required to accommodate machines to be worked on. If wood-frame construction is being undertaken, consult a local agricultural engineer regarding the correct size and spacing of wall studs and ceiling rafters or trusses. Refer also to Canada Plan Service drawings and leaflets for typical design details.

Use a minimum of RSI 3.5 fire resistant insulating material in the walls and ceiling to reduce heat losses. Do not use plastic foam insulation such as polyurethane. Line the inside wall with a layer of vapor barrier over which a sheathing such as plywood is applied. In addition, sheathe the bottom 1200 mm of the wall surrounding the welding and metalwork area with either sheet metal or asbestos board as a fire prevention measure.

A light-colored semigloss paint on the inside walls and ceiling will make the lighting much more effective and facilitate cleaning.

Finish the outside walls and roof with sheet metal, wood, stucco or other durable material. In planning the exterior style and finish of the building, consider

shapes, materials and colors that will harmonize with other buildings on the farmstead. Design the roof so that the snow or ice will slide or drip away from the main door and apron area.

Doors and Windows

It is impractical to install enough windows to provide adequate light for working inside the shop. Windows should be sized and located for convenient viewing of the house and farmyard rather than for lighting. They are also useful for ventilating the building in hot weather.

A door 3600 mm high will accommodate most large tractors equipped with cabs, but self-propelled combines may require door heights in excess of 4000 mm. A minimum width of 4200 mm is required for entry of many commonly used machines. For a large shop that will also be used for storing the farm truck or a frequently used tractor, consider installing a second service entrance smaller and less cumbersome than the main one. Overhead-mounted or sliding-type doors are preferable to those mounted on hinges. Insulate doors to prevent frosting up in cold weather.

Install at least one small convenience door, preferably opposite the main door, to provide a secondary exit in case of fire. This door should be of standard size, 910 mm x 2030 mm, so that materials and small equipment can be moved in and out of the shop without opening the main door.

SERVICES

Heating

In most areas of Canada, heat is required in the shop for part of the year, but is not likely to be needed continuously or regularly. When deciding which type of heating facility to install, consider the following:

- How much does it cost to install?
- How much does it cost to operate?
- How safe is it?
- How long does it take to heat the shop?
- How satisfactory is the heat distribution?
- How much floor space is required to accommodate the system?

The energy source for the heating system may be electricity, fuel oil, propane gas, coal or wood.

Floor-mounted space heaters (usually equipped with air-circulation fans) are commonly used, but have the disadvantage of taking up valuable floor space. Fan-equipped gas-fired units suspended from the ceiling are ideal for shop use. Select one with a quiet-running fan. Radiation-type overhead heaters operate quietly and should also be considered. Electric floor heating cable embedded in the concrete is likely to result in undesirable foot discomfort.

Ventilation

Ventilation of a shop is necessary to remove hazardous fumes and gases and to provide a measure of comfort cooling. Some cooling can be attained by opening doors and windows but it is essential to have an exhaust fan to ensure adequate removal of gases and fumes.

Mount the exhaust fan in the wall, close to the ceiling and preferably near the welding area. It is also desirable to have the fan hooded and mounted on a wall facing away from the prevailing winds to minimize back drafts.

The fan should have sufficient capacity to provide a complete air change every 2 to 3 minutes. A two-speed fan facilitates rapid removal of air when welding or in hot weather and minimizes heat loss in cold weather.

When operating internal combustion engines, attach a flexible tube to the engine exhaust pipe to convey the gases directly outdoors through a permanently

installed wall port. To prevent reentry of the exhaust fumes, locate this wall port well away from any doors. Whenever possible, run the engines outside.

Lighting

Ensure adequate lighting since much of the shop work is done on dull days and evenings.

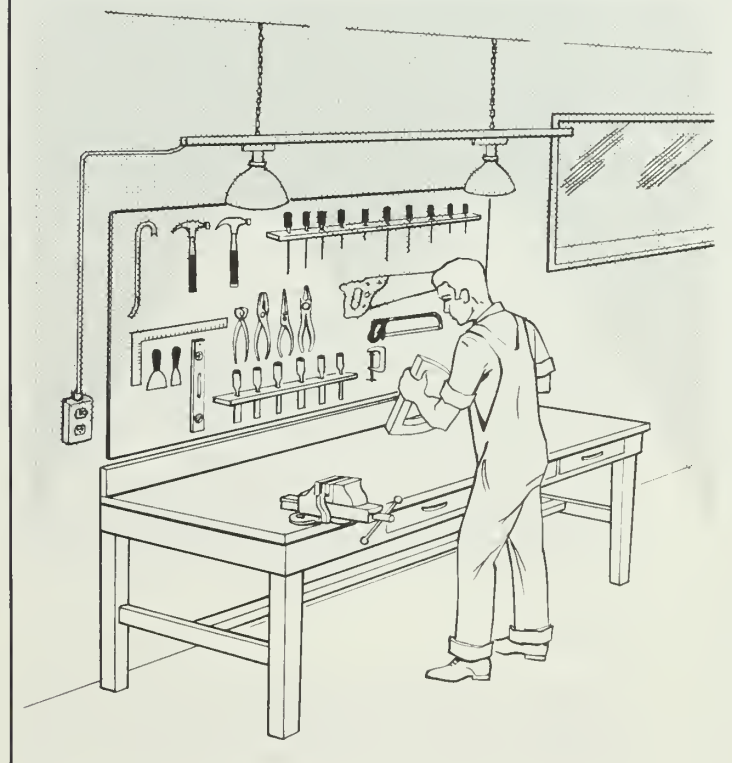
For general shop lighting, 300-watt lamps spaced 3000 mm to 3600 mm apart are required. To provide working clearance, it is necessary to install the lamps 3000 mm to 3600 mm above the floor.

For workbenches where lamps can be suspended 1200 mm overhead, use either a 1200 mm fluorescent fixture with 40-watt tubes or two 150-watt reflector lamps spaced 1200 mm apart. This eliminates shadows (Figure 5).

When installing lights, you have a choice of standard lamps with separate reflectors, reflector-type flood lamps or fluorescent fixtures.

A major problem in shop lighting is keeping reflectors and bulbs clean. Light output can be reduced by up to 50% if bulbs and reflectors are not cleaned periodically.

Figure 5 Proper lighting is essential to eliminate shadows in work area



Have individual lighting for each major shop tool such as a grinder or drill press. An adjustable 60-watt lamp fastened to the tool is generally satisfactory. These lamps should plug into convenience outlets to facilitate portability.

A portable stand-type lamp is also very useful for working on implements in the service area.

An outside flood lamp at the main entrance door is recommended to provide the outside apron area with light.

Electrical Power Outlets

Since electrical wiring standards are subject to comprehensive provisions of the Canadian Electrical Code as well as varying provincial regulations, specific wiring recommendations are not given in this bulletin. Consult a qualified electrician or power utility company advisor in completing the wiring plan for a farm shop.

The following guidelines may be useful in the general planning of the wiring system:

- Be sure that the electrical service entrance has some reserve capacity to allow future expansion. In most cases, the minimum capacity should be 100 amperes, 115/230 volts.
- Provide convenience outlets for both 115 and 230 volts. Electric motors over 375 W should be wired for 230 volts.
- Place the 230-volt outlet for the welder close to the main entrance to facilitate use of the welder either inside or outside. The smallest transformer type AC welders draw 35 amperes.
- Space convenience outlets (115 volts) about 3000 mm apart along the walls, keeping in mind that outlets serving electrically driven equipment, such as a grinder, should be positioned as close as possible to the normal operating location of the machine.
- Space convenience outlets serving workbenches about 1200 mm apart.
- Use "plug-ins" wherever possible rather than permanent "wiring-in" to maximize flexibility in the use of electrically operated tools and equipment.
- A weatherproof 115-volt outlet on the outside near the shop door is handy for engine block heaters and trouble lamps.

Water

Install a frost-free hydrant inside the shop, close to the door, for cleaning floors and machines, filling radiators and as a possible fire control measure.

Communication

Some form of communication between the house and shop is extremely useful. Possibilities that might be considered include: visual communication (windows), extension telephone, intercom or radio. Intercom cables may be placed underground when trenching for other purposes, such as the waterline.

PLANNING THE FLOOR ARRANGEMENT

In general, lay out the floor plan of the shop in a manner that provides the most convenience for the operator and the most efficient use of available space (Figure 2). The service area located immediately inside the main door will occupy a major part of the floor space. However, separate floor space should be provided for a) welding and machine shop activities, b) mechanical repair and service work, and c) woodwork.

It is very important that a special area be designated for welding and machine shop work so that extra precautionary measures can be incorporated to reduce the risk of fire and injury. Use portable screens (Figure 6) to isolate this area and shield other occupants of the shop from sparks, flying metal and electric arc flashes. Normally the welding area is located close to the main entrance so that welding can be done outside as well as inside without moving the welding equipment.



Figure 6 Welding equipment with cart, table and welding screen

If woodworking activities are likely to be limited, it may not be practical to provide separate shop space for this purpose. However, if both woodworking and mechanical servicing are being done in the same area, take special care to keep the area free of oil and grease to prevent petroleum stains on lumber being used or stored.

Once the shop floor space has been subdivided on the basis of activity, shop equipment, tools and supplies can be placed where it is most convenient to use them. Avoid anchoring equipment to the floor or walls. For maximum flexibility, use sturdy stands equipped with castors or rollers for mounting grinders, welders, drills, table saws, and similar items.

Bolt bins, storage cupboards, material storage racks and tool boards for larger tools not normally carried in the toolbox should be strategically placed along the walls as close as possible to the area in which related activities will be undertaken.

EQUIPMENT

Hoists

Lifting devices should not be suspended from structural parts of the building unless special provisions are made in the design of the building to support such loads.

For normal farm shop activities the most practical and useful type of hoist is a mobile, overhead rail with a suspended chain block (Figure 2). Such a hoist can be easily and economically constructed using a steel "I" beam. It is completely maneuverable and can be used outside as well as inside the shop.

Welders

Both oxyacetylene and electric arc welders are extremely useful in any shop operation. The oxyacetylene is the more flexible since it can be used for heating, straightening, cutting, brazing and soldering as well as welding, but it is also more difficult to operate than the arc. Single-stage pressure gauges are adequate for general farm use. Mount the acetylene and oxygen tanks on a two-wheeled dolly for easy movement to each job (Figure 6).

Electric arc welders are available in either engine-driven or electrically activated models. Engine-driven models require regular servicing, are noisy and must have the exhaust vented to the outdoors. However, they have the advantage of being portable and can be taken to any job site. A 200-ampere-capacity arc welder is adequate for most farm jobs. Before buying an electric welder, make sure the farm electrical service can provide adequate power.

Air Compressor

Compressed air is an invaluable aid in any shop operation. Air compressors are usually driven by electric motors but gasoline engines can be used if portability is required.

Compressors are available in a wide range of sizes. For average farm use, a twin-cylinder model, approximately 750 to 1500 W, delivering 170-225 L/min at 275 kPa pressure, with a tank capacity of 55 to 65 L, will meet most requirements. Set the tank pressure switch to cut off at about 700 kPa.

Steam Cleaner

Where a considerable amount of engine overhaul work is contemplated a steam cleaning unit may be considered. However, steam cleaners require considerable attention in their operation and maintenance; also, they create ventilation problems in the shop. Do initial washing and cleaning of equipment outside whenever possible.

Drill Press

A drill press is a necessity if precision drilling is to be accomplished. Mount the machine on a stand that can be moved to accommodate various sizes and shapes of materials to be drilled. Hang clear lens goggles in a handy location on the machine for use during its operation.

Power Hacksaw

An electrically powered hacksaw is an extremely useful labor-saving device. Like the drill press, it should be mounted in such a way that material can readily be fed into the machine.

Power Grinder

A heavy-duty pedestal-mounted mandrel with readily replaceable grinding wheels, wire brush and buffing attachments is a necessity in any shop. Usually the grinder is located close to the welding area. It should be moveable or readily accessible so that odd-shaped materials can be accommodated. Consider also belt-type or rotary-disc grinders for specialized jobs. Again, keep goggles handy for use whenever grinders are operated.

Hydraulic Press

Installation of commercially made hydraulic press equipment may not be warranted because of its high cost and infrequent use. However, by using



Figure 7 A hydraulic press

scrap materials and applying some ingenuity, you can build very satisfactory press equipment at a reasonable cost (Figure 7).

Woodworking Equipment

A good quality table saw and a jointer will enable you to undertake most of the woodworking activities required on the farm. Mount these on moveable stands so that they can be moved to an open area to accommodate long material or plywood sheets. If you enjoy hobby work, you might also consider such items as a band saw or wood lathe. A separate woodworking bench with a wood vise is preferable if adequate space is available.

Fire Extinguishers

Carbon dioxide or other dry-chemical-type extinguishers should be placed immediately inside each shop door so that they can be reached without entering the building. These extinguishers are best for oil-fed or electrical fires. Use at least 20-BC- or 20-ABC-rated extinguishers. In addition, have pails of dry sand strategically located inside the shop and, if a water supply is available in the shop, keep a water hose handy.

Machine Stands

Repair work should never be undertaken on or under a machine that is supported only by a jack or hoist.

Every shop should be equipped with a number of sturdy metal machine stands as well as a good supply of sound wood blocking material (Figure 8). With a bit of ingenuity, excellent machine stands can be made from scrap metal.

Workbenches and Tables

- A mechanic's workbench (Figure 9) can be built of dimension lumber and should be about 900 mm high, 600 mm deep and approximately 1800 mm long. Although the bench can be attached to the wall to provide some stability, all of the weight should be supported by legs standing on the floor. This ensures that impact loads, such as hammering, are transferred directly to the floor. Covering the bench top and edges with light-gauge sheet metal provides a good working surface that is easy to keep clean. A vise is an essential part of any shop workbench.
- If a portable workbench is preferred, reduce the length to approximately 1500 mm and increase the width to 750 mm to provide some stability. The frame of the bench can be built with 50 mm iron pipe with a wooden top. Place castor wheels only on two legs at one end of the bench. Put handles on the other end for lifting when the bench is to be moved.
- Equip the welding area with an all-steel table, approximately 750 mm high with a 750 x 900



Figure 8 Machine stands made from scrap metal



Figure 9 Workbench with vise and tool box

mm top. Either pipe or angle iron can be used for the legs and the top should be at least 6 mm thick. Attach a vise as in Figure 6.

STORAGE

Tools

Keep small, frequently used hand tools, such as pliers, screwdrivers, sockets and flat wrenches, in a metal toolbox, so that they can be easily carried to the work site (Figure 9). Mount larger and less frequently used tools, such as saws, hammers and gear pullers, on a tool board. Avoid hanging tools haphazardly on the walls of the shop.

Materials

- Use batteries of open-face bins of various sizes for the storage of bolts, repair parts, etc. Label each bin with an appropriate description of the contents.
- Store lumber and bulk steel on specially constructed racks for easy access. Avoid piling this type of material on the floor or standing it in a corner.
- Store oil, paint and other inflammable or odorous materials in cupboards equipped with tight-fitting doors.

CONVERSION FACTORS FOR THE METRIC SYSTEM

Length		Mass	
1 mm	= 0.039 in.	1 g	= 0.035 oz (avdp)
1 cm	= 0.394 in.	1 kg	= 2.205 lb
1 dm	= 0.328 ft	1000 kg	= 1.102 ton (short)
1 m	= 3.281 ft	1 t	= 1.102 ton (short)
1 m	= 1.094 yd		
1 km	= 0.621 mi		
Area		Speed	
1 cm ²	= 0.155 in. ²	1 m/s	= 2.237 mph
1 dm ²	= 0.108 ft ²	1 km/h	= 0.621 mph
1 m ²	= 10.764 ft ²		
1 m ²	= 1.196 yd ²	Pressure	
1 ha	= 2.471 ac	1 N	= 0.225 lb force
1 km ²	= 0.386 mi ²	1 kPa	= 0.145 psi
		1 kPa	= 0.295 in. of mercury
		1 Pa	= 0.0075 mm of mercury
Volume		Power	
1 cm ³	= 0.061 in. ³	1 W	= 3.413 Btu/h
1 L	= 0.035 ft ³	1 W	= 0.738 ft.lb/s
1 m ³	= 35.315 ft ³	1 W	= 0.00134 hp
1 m ³	= 1.308 yd ³	1 kW	= 1.34 hp
1 L (litre)	= 0.880 qt		
1 L	= 0.220 gal		
1090 L/ha	= 8.9 gal/ac		

